

# **Simulations of climate change at low and high resolution**

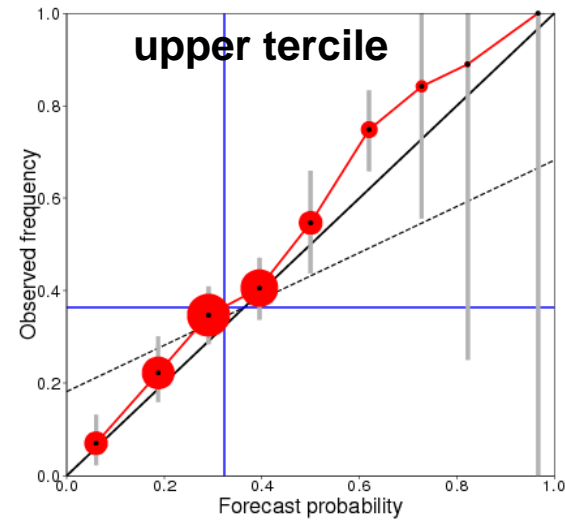
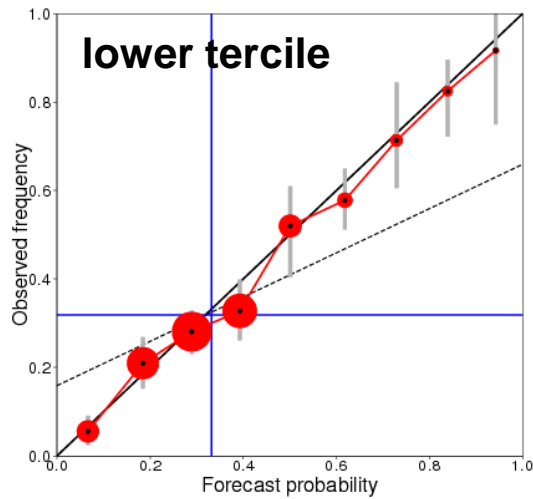
## **Testing the Concept of Seamless Prediction**

T.N.Palmer (ECMWF) and Mio  
Matsueda (MRI)

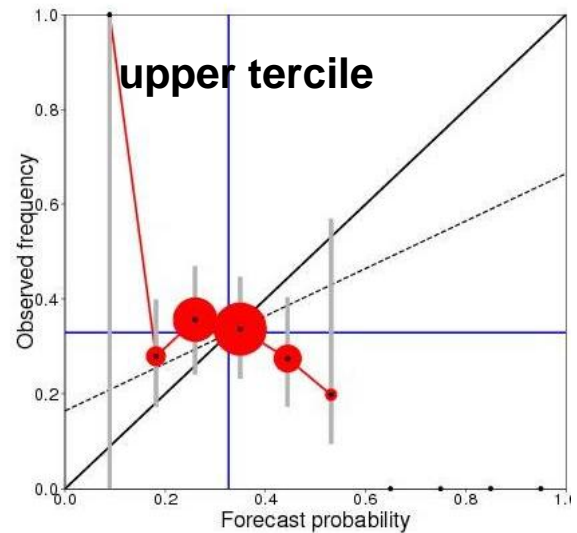
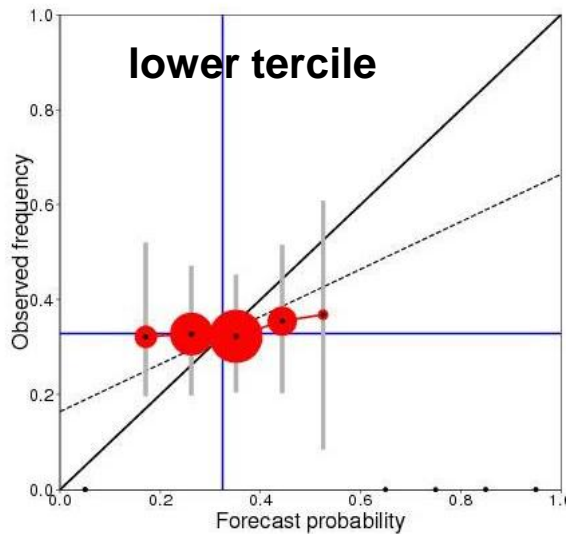
with thanks to Paco Doblas-Reyes, Mark  
Rodwell and Antje Weisheimer, ECMWF

**DJF precipitation Nov start dates (lead time 2-4 months), 1980-2001**  
**ENSEMBLES REFORECAST reliability diagrams**

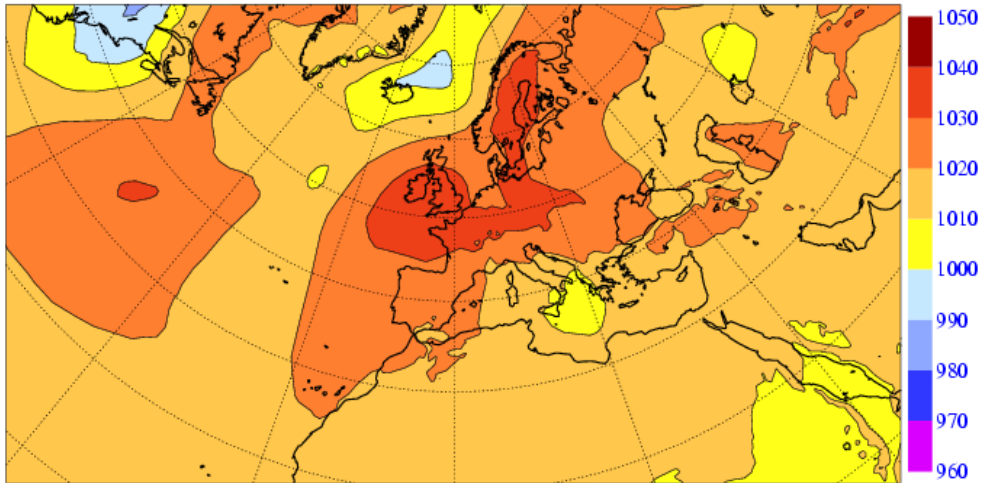
**Amazon**



**N Europe**



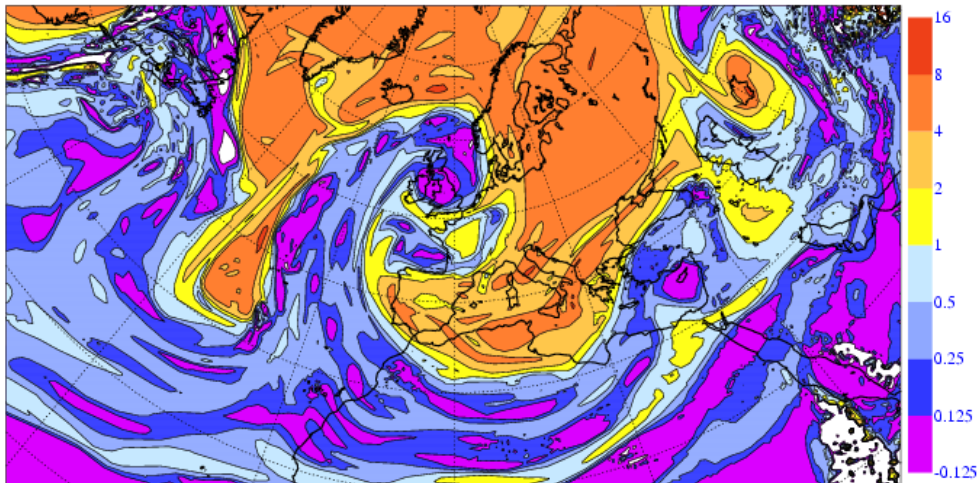
## Surface Pressure



## Persistent Blocking Anticyclone

Indications that higher resolution (Matsueda et al 2009) can significantly improve realism of simulations of long-lived blocks

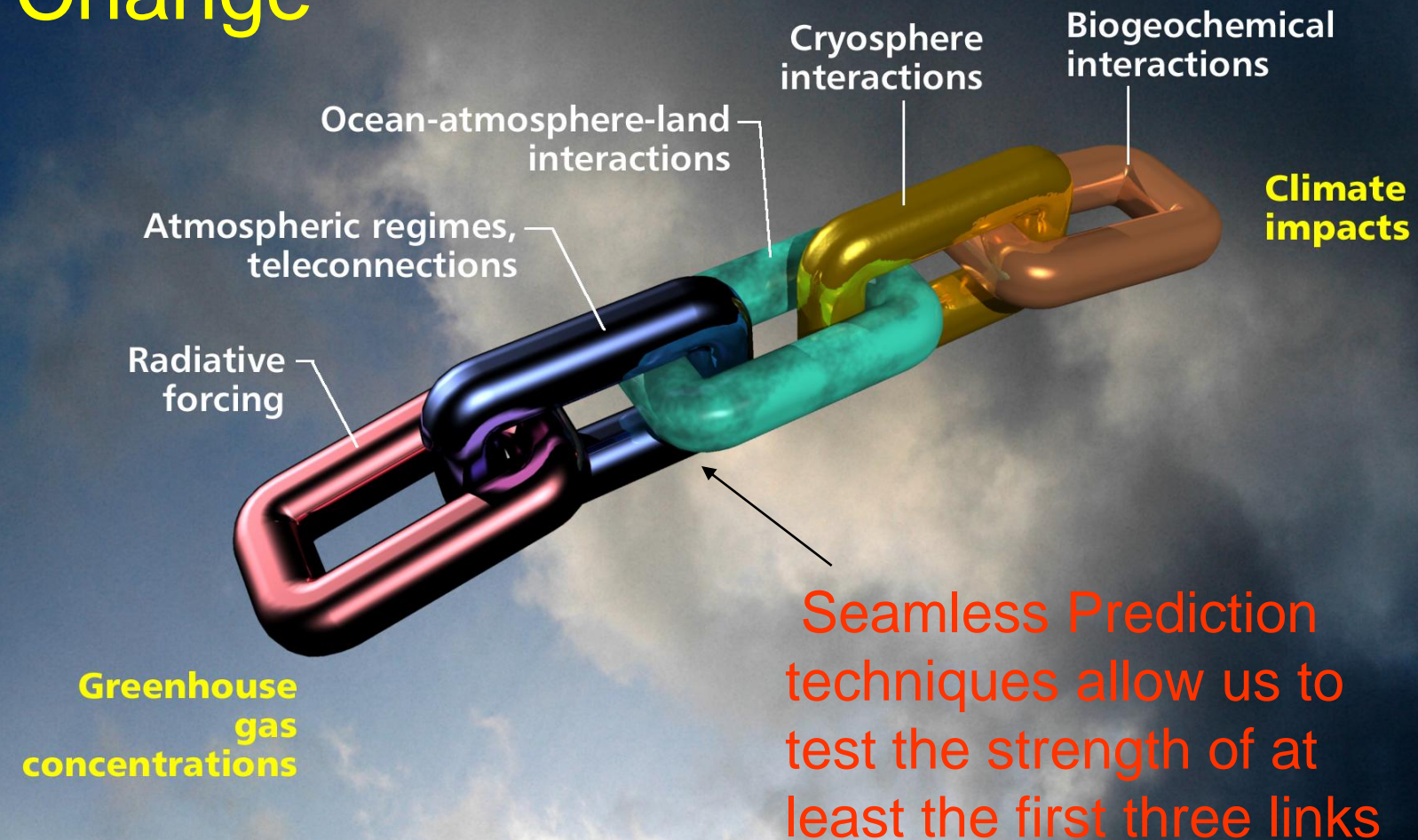
## Potential Vorticity on 315K



How do we assess the reliability of an ensemble-based precipitation forecasts of climate change?

Should the unreliability of SI ensemble forecasts be of concern?

# A Nonlinear Perspective on Climate Change



Should the unreliability of SI ensemble forecasts be of concern in climate-change prediction?

Yes it should (Palmer et al, BAMS, 2008)

No it shouldn't (Scaife et al, BAMS, to appear)

Oh yes it should! (Palmer et al, BAMS, to appear)

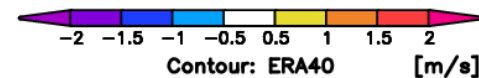
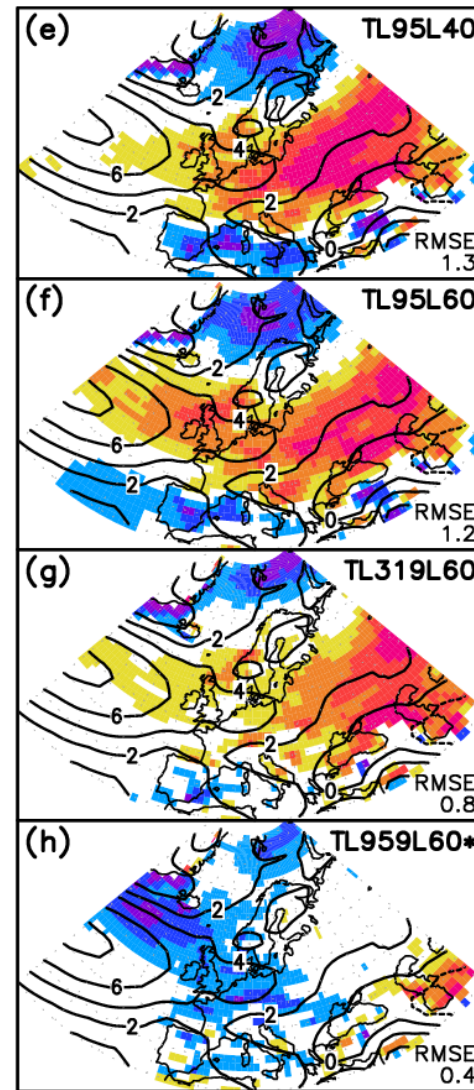
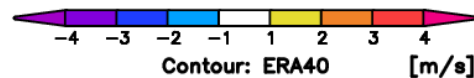
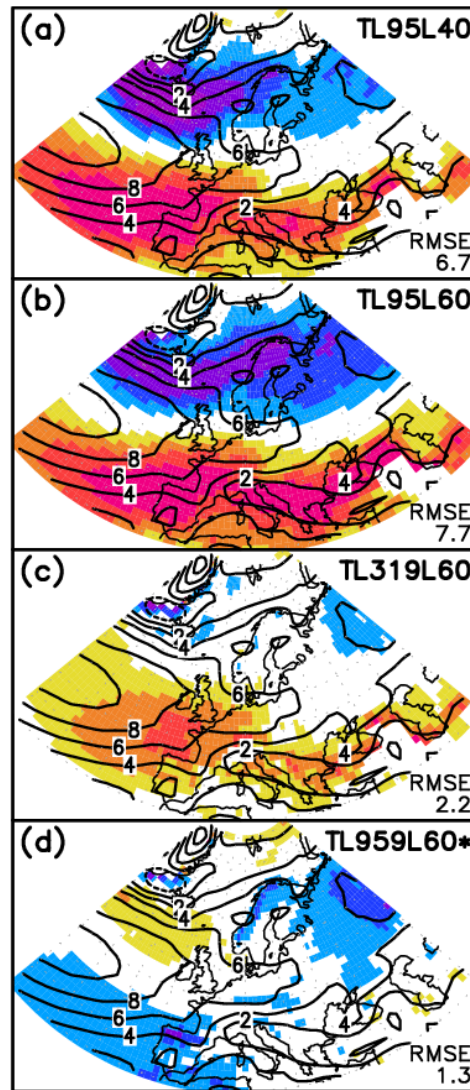
How to decide who is right?



# U850 bias against ERA40 over Europe

DJF

JJA



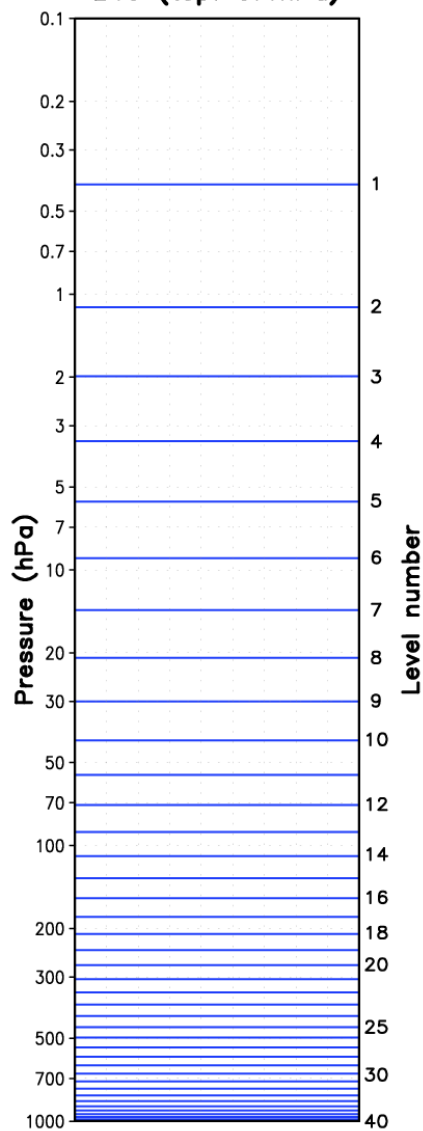
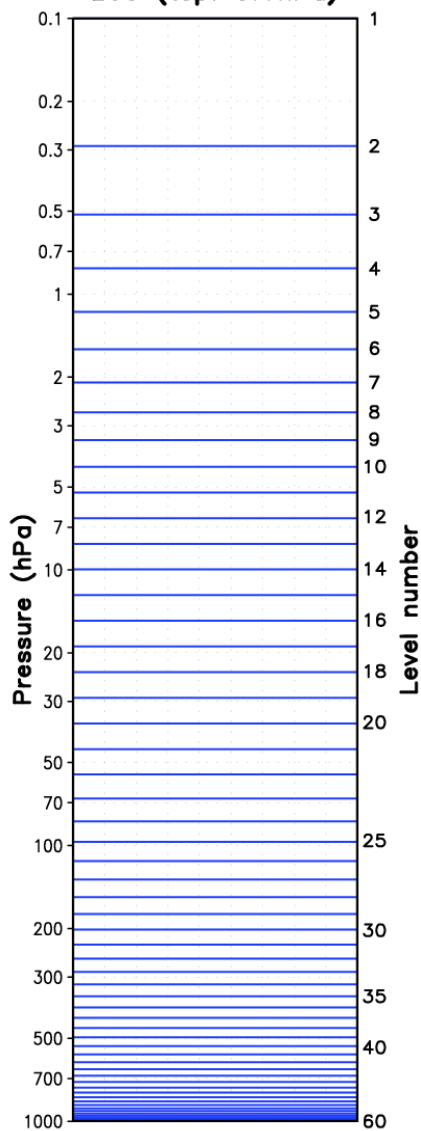
MRI AGCM  
based on  
JMA NWP  
model. Run  
20<sup>th</sup> Century  
“control” and  
21<sup>st</sup> Century  
“timeslice”  
integrations

Matsueda  
and Palmer,  
2009

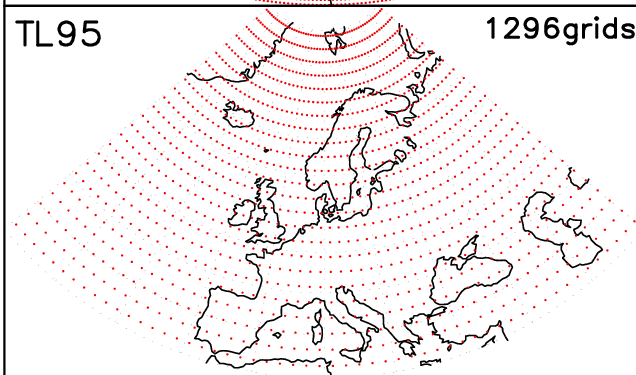
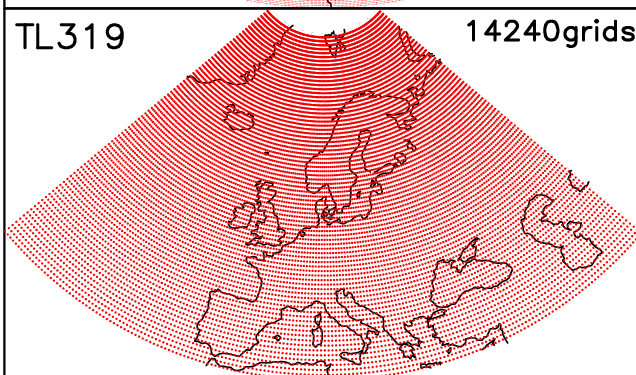
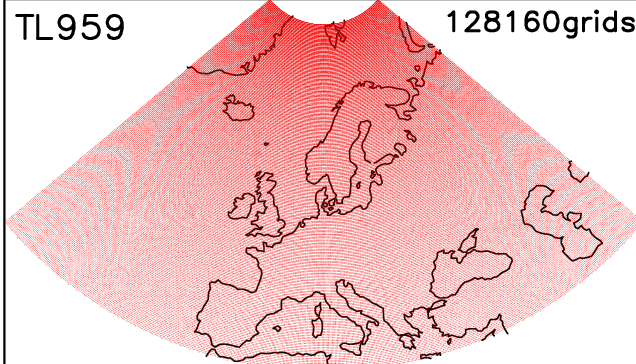
# Distribution of vertical levels (JMA/MRI AGCM)

L60 (top: 0.1hPa)

L40 (top: 0.4hPa)

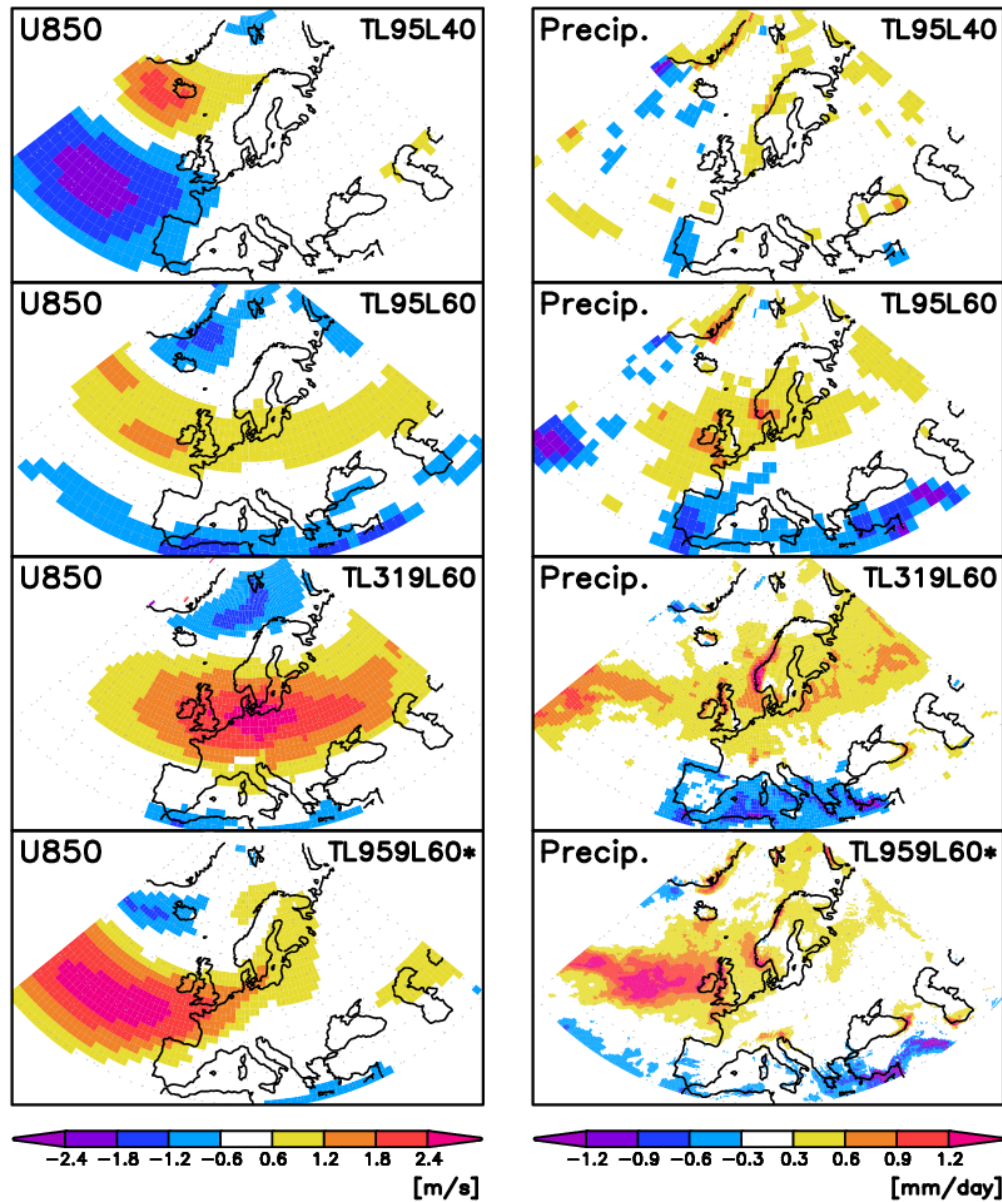


# Gaussian grids (JMA/MRI AGCM)

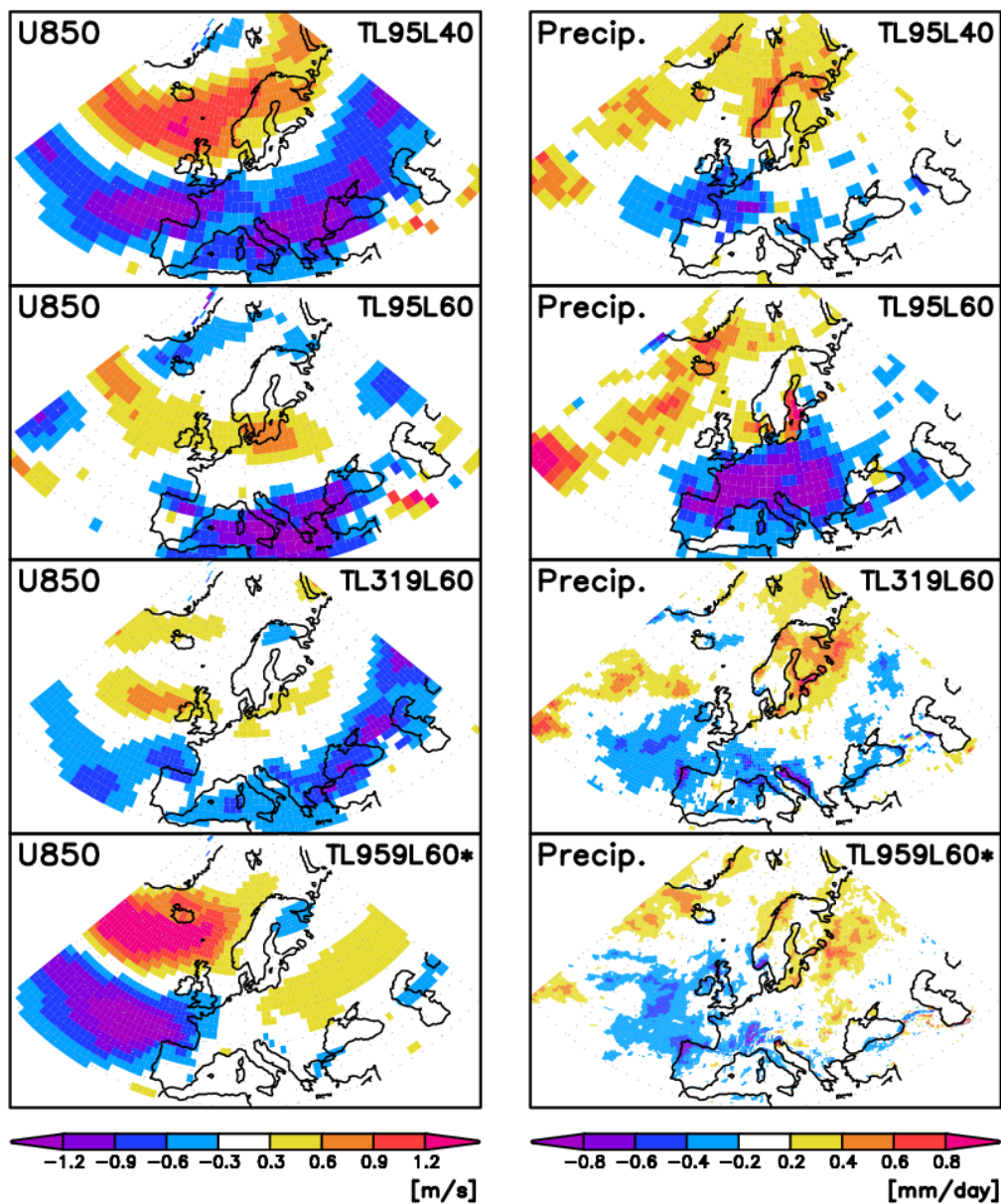




## Climate change signal over Europe (DJF)



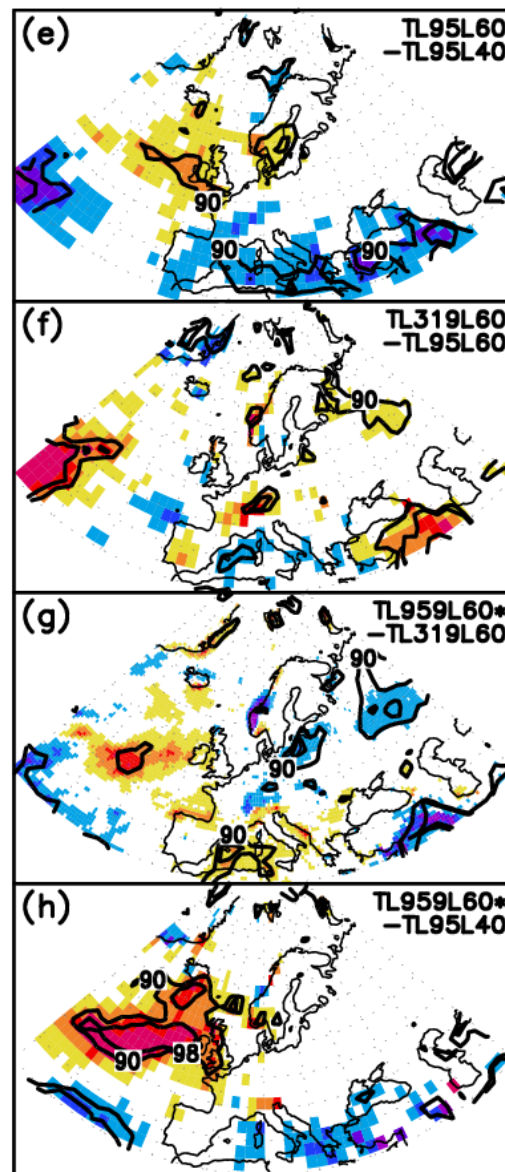
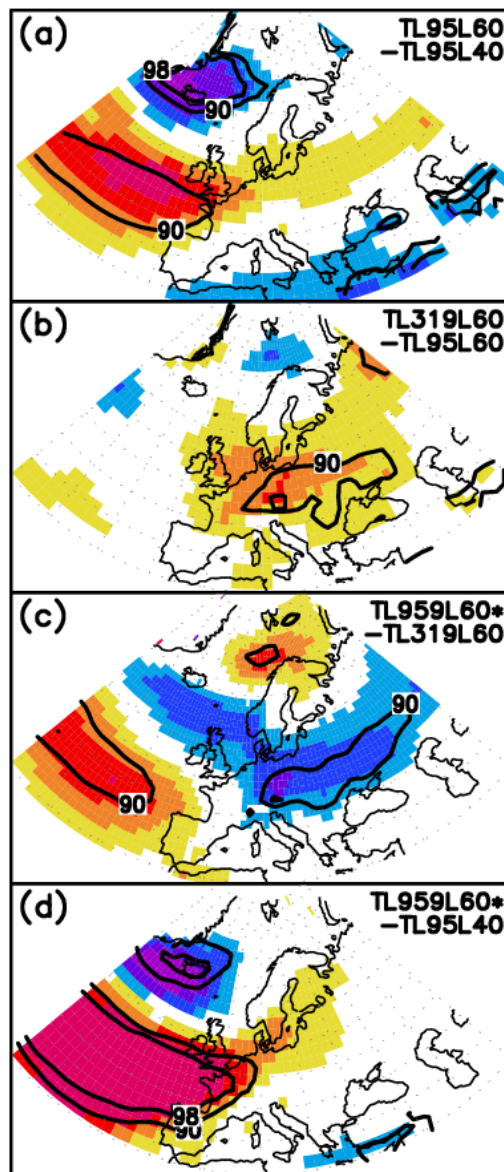
## Climate change signal over Europe (JJA)



# Climate change signal differences over Europe (DJF)

U850

Precipitation

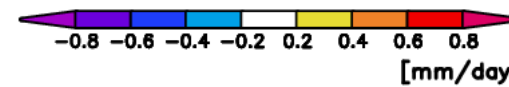
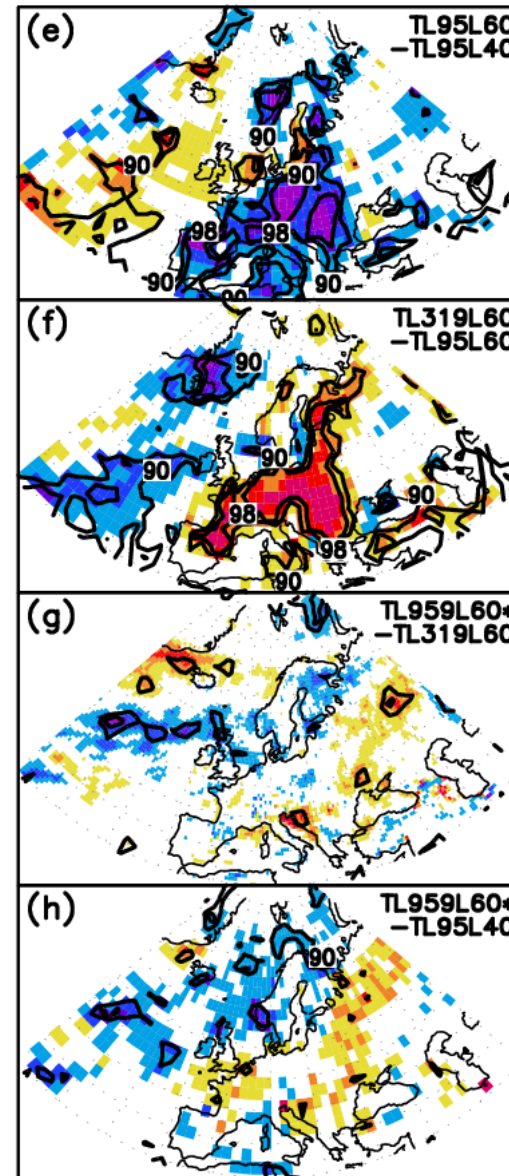
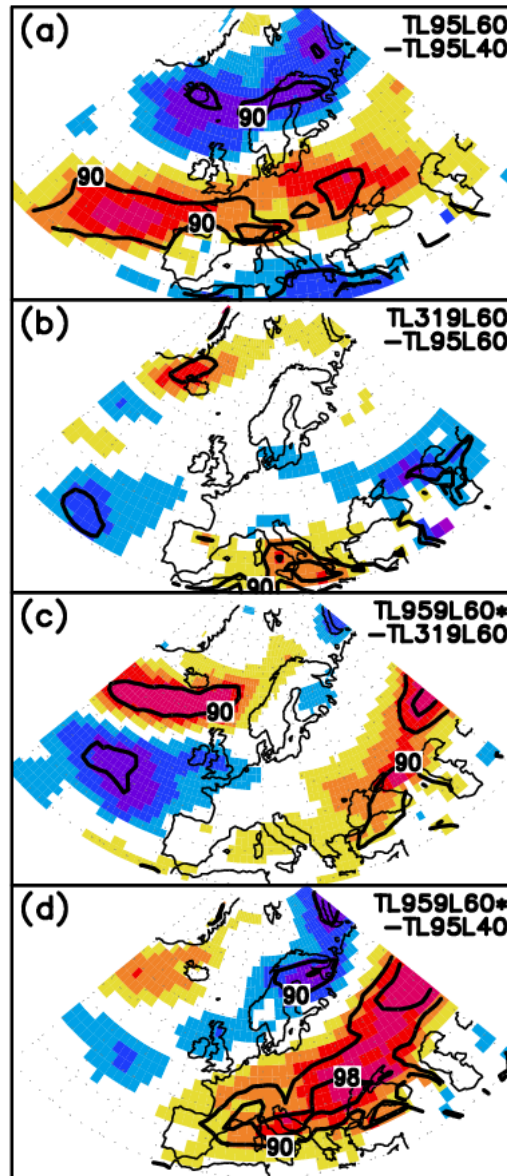


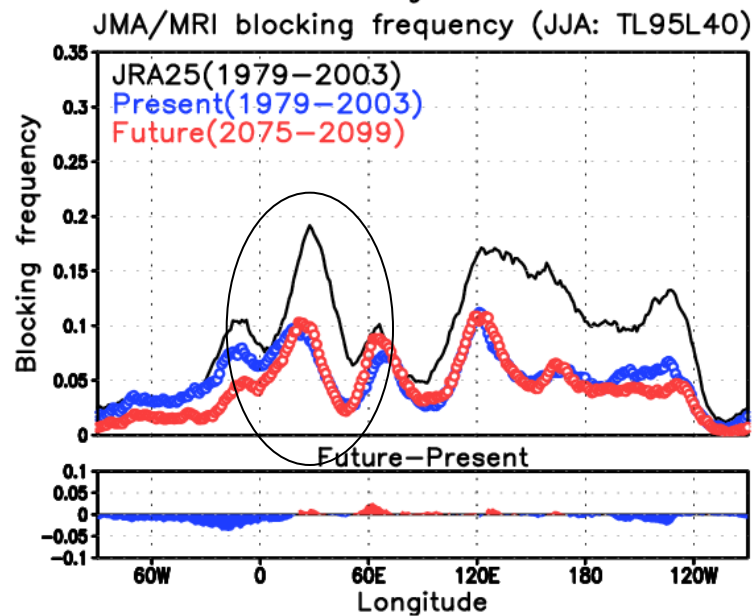
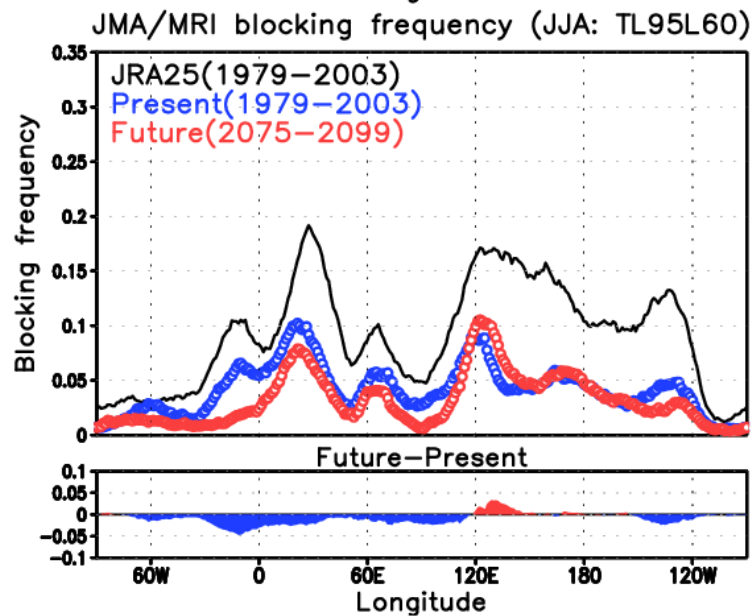
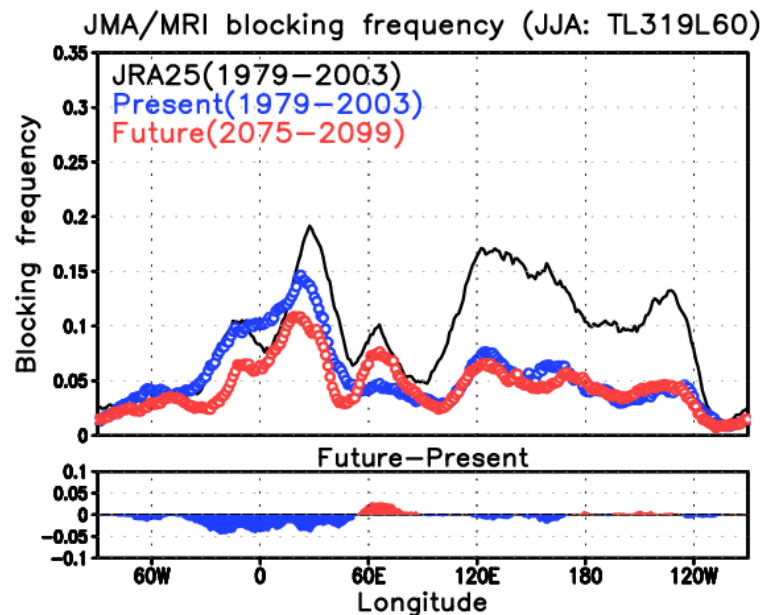
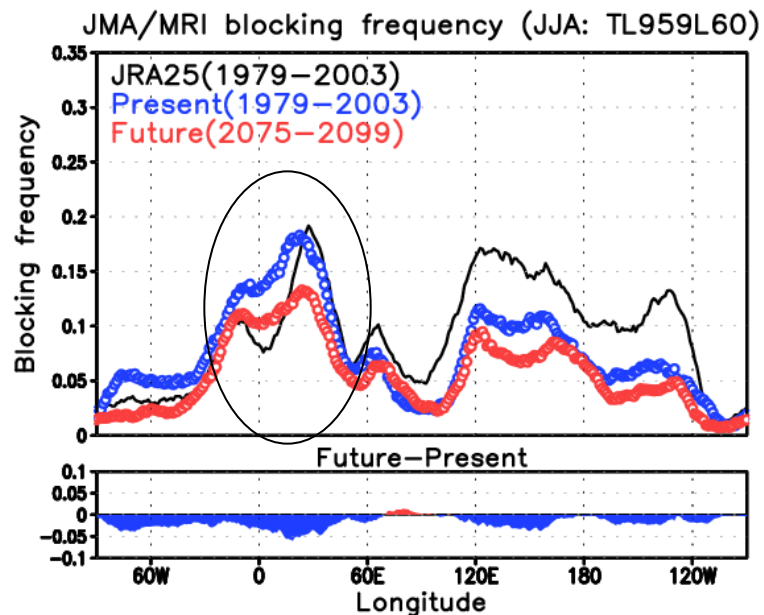


# Climate change signal differences over Europe (JJA)

U850

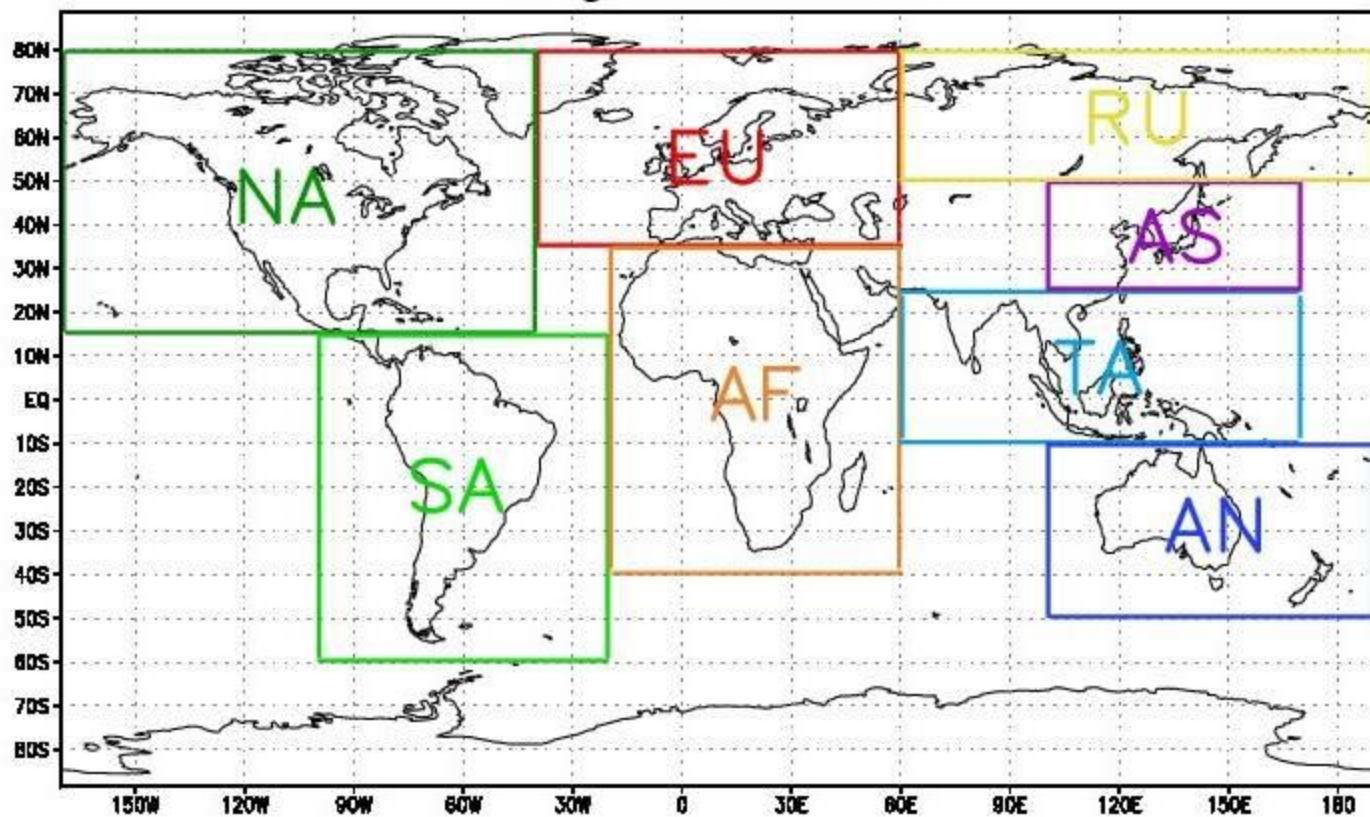
Precipitation







## Regions defined



Correlation between 180km-model  
 (“**model**”) climate change signal and  
 20km-model climate change signal  
 (“**truth**”) (U850)

| season | region | C_i   |
|--------|--------|-------|
| DJF    | AF     | 0.29  |
|        | AN     | 0.70  |
|        | AS     | 0.85  |
|        | EU     | -0.77 |
|        | NA     | -0.09 |
|        | RU     | 0.70  |
|        | SA     | 0.74  |
|        | TA     | 0.78  |



|     |    |       |
|-----|----|-------|
| JJA | AF | 0.64  |
|     | AN | 0.82  |
|     | AS | 0.74  |
|     | EU | 0.53  |
|     | NA | 0.70  |
|     | RU | -0.52 |
|     | SA | 0.81  |
|     | TA | 0.88  |



Could 20<sup>th</sup> Century SI  
information about where the  
“**model**” is most unreliable (ie  
departs most from “**truth**”) be  
used to “predict” where the  
21<sup>st</sup> Century “**model**” climate  
change signal is most  
inaccurate (ie departs most  
from “**truth**”- eg Europe)?

# Bias of “model” vs “truth” from 20<sup>th</sup> Century control runs (U850)

|     |    |      |
|-----|----|------|
| DJF | AF | 0.94 |
|     | AN | 0.98 |
|     | AS | 0.92 |
|     | EU | 0.65 |
|     | NA | 0.97 |
|     | RU | 0.91 |
|     | SA | 0.99 |
|     | TA | 0.96 |





# Bias of “model” vs “truth” from 20<sup>th</sup> Century control runs (U850)

|     |    |      |
|-----|----|------|
| JJA | AF | 0.97 |
|     | AN | 0.98 |
|     | AS | 0.78 |
|     | EU | 0.89 |
|     | NA | 0.99 |
|     | RU | 0.73 |
|     | SA | 0.97 |
|     | TA | 0.98 |



Weight “model” climate-change signal  
using 20<sup>th</sup> Century “model-truth”  
correlation.

|     | Raw | Calibrated |
|-----|-----|------------|
| DJF | .40 | .52        |
| JJA | .58 | .68        |

# Conclusions

- Support for seamless prediction concept
- Important and urgent need for more substantial assessment of the impact of resolution in time-slice mode on climate-change signal for weather-related variables.
- At what resolution is there “convergence” of “synoptic”-scale climate-change signal for these variables from these timeslice integrations?
- This should be a minimum resolution requirement for running fully coupled climate-change integrations, and will inform (and provide objective resolution criteria for) future HPC needs.